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A new family Kazimierzidae for the genus *Kazimierzus*, earlier recorded to the composite Microchaetidae (Annelida, Oligochaeta)

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Abstract

A review of the genus *Kazimierzus* Plisko, 2006, based on available type material enriched by study of selected specimens from the earthworm collection gathered at the NMSA and literature, revealed that the species presently accredited to this genus are characterized by unique features and clearly differ from the species of the other genera endorsed to Microchaetidae. Basing on this discovery the genus *Kazimierzus* is separated from Microchaetidae and Kazimierzidae fam. n. is erected to accommodate the whole 21 species of this genus. Species accredited to the new family Kazimierzidae are listed, their peculiar characters and specific distribution discussed.

Keywords

Kazimierzus, Oligochaeta, South Africa, megadrile, earthworms, indigenous species, Afrotropical region

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Introduction

Twenty of the studied species of the genus *Kazimierzus* Plisko, 2006 initially were described in the composite genus *Microchaetus* Rapp, 1849 what at that time incorporated the majority of the known South African indigenous earthworm species. The only *K. sirgeli* (Plisko, 1996) was described in *Proandricus* Plisko, 1992 although its exceptional characters were noted, several times underlined (Plisko 1996, 2002, 2003) and the species was transferred to this genus (Plisko 2006). *K. rosai* (Michaelsen, 1908) and *K. peringueyi* (Michaelsen, 1913) are the oldest species of this genus. Over sixty years after their description, the five species: *crousi, franciscus, guntheri, ljungstroemi* and *personianus* were described by Pickford (1975) also in *Microchaetus*. Plisko (1998) described other species: *alipentus*, *circulatus*, *davidi*, *hamerae*, *imitatus*, *metandrus*, *obscurus*, *occidualis*, *occiduus*, *pauli*, *pentus*, *senarius* and *sophieae* (Plisko 2002), placed them as well in *Microchaetus*, although pointed their distinctive features and debated species' exceptional position in this genus. Re-examination of the distinctive characters observed in the 21 species occurring in limited area of the Western Cape permitted Plisko (2006) to erect for them a new genus *Kazimierzus*. The earlier debates on systematic position of the species accredited to *Kazimierzus* and note on species' restricted geographical occurrence in the Western Cape (Plisko 1998) lead to present review of this genus. Closer assessment of the generic characters observed in the species ascribed to *Kazimierzus* revealed that these, differing from the features occurring in the genera *Microchaetus* Rapp, 1849, s. str., *Geogenia* Kinberg, 1867 and *Proandricus* Plisko, 1992, accredited to Microchaetidae (summarized in Table 1) indicate inconsistency in the family. Thus a new family Kazimierzidae is erected to accommodate these species.

Material and methods

In order to evaluate the status of the genus *Kazimierzus* the following material was examined: the types of *K. franciscus* (SAM 21542), *K. guntheri* (SAM 21543), *K. ljungstroemi* (SAM 21541) and *K. pearsonianus* (SAM 21544) kindly loaned by Iziko, the South African Museum, Cape Town to the KZN Museum, Pietermaritzburg; the types and other material of fourteen species: *alipentus*, *circulatus*, *davidi*, *hamerae*, *imitatus*, *metandrus*, *obscurus*, *occidualis*, *occiduus*, *pauli*, *pentus*, *senarius*, *sirgeli* and *sophieae* gathered at the NMSA collection. Although the types of *K. crousi* (Pickford, 1975), *K. peringueyi* (Michaelsen, 1913) and *K. rosai* (Michaelsen, 1908) accredited to this genus by Plisko (2006) were not studied, the literature has assisted in establishing their identity and indicated their specific generic features.

The characters investigated were: the dorsal blood vessel; excretory system with its shape of nephridial bladders; seminal vesicles, considering their number, position, shape and extension; male funnels condition; anterior septa: their number and thickness, with special attention to septum 6/7 and 9/10; body shape, dimensions and the

number of segments. The earthworms were examined under a stereo dissecting microscope. Diagnoses and species descriptions follow Plisko (1996, 1998, 2002).

Acronyms and abbreviations used in this paper: SAM – Iziko, South African Museum collection, Cape Town; NMSA – KwaZulu-Natal Museum, collection and South Africa database.

Taxonomy

Kazimierzidae Nxele & Plisko, fam. n.
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Type genus. *Kazimierzus* Plisko, 2006: 46.

Diagnosis. Dorsal blood vessel simple throughout the body, rarely enlarging in segments 8 or 9. Excretory system holoic with nephridial bladders proclinate J–shaped. Testes arranged in holandric (male funnels in segments 10 and 11) or metandric (male funnels in segment 11) condition, enclosed or free. Seminal vesicles one or two pairs, confined to one or two segments (in 11 or 12, or in 11 and 12); the latter pair may be extended backwards, behind segment 12 (sometimes to segment 30). Spermathecae testicular or post testicular. Oesophageal gizzard in 7, muscular. Some of the preclitellar septa 4/5–9/10 variably thickened. Calciferous glands not stalked, in one or two segments (9, 10 or 11): encircling oesophagus with vestigial medial and dorsal grooves, or dorsoventral, paired, with obvious medial and dorsal grooves. Secondary annulation of preclitellar segments present; segment 1 and 2 fused appearing as one segment, 4–9, 10 ringleted with 2 or 3 ringlets, annulated or not. Setae minute, eight per segment in four pairs.

Description. Pigmented or not; alive violetish-grey or grey; preserved whitish grey. Body length not exceeding 350 mm, and 2–15 mm wide at tubercula pubertatis. Average number of segments 100–550. Setae minute; on preclitellar segments visible on various segments or easily visible on papillae, on post clitellar segments in regular rows. Female pores paired, in 14. Clitellum saddle-shaped. Tubercula pubertatis variable in shape and location. Papillae present, located variably. Spermathecal pores located in or behind testis segments. Vasa deferentia paired in holandric, one pair in metandric species. Genital glands various in size and position. Spermathecal ampullae with variably shaped ducts.

Distribution. All species presently accredited to *Kazimierzus* are known from a limited area in the western and south-western Atlantic coast of South Africa. The distribution of these species is poorly known as the most known species have only been collected from their type localities, some species represented only by a holotype. The species are known from variable biotopes: wet, muddy soil, or very dry soil; collected between hard rocks in mountain areas characterized by winter-fall and associated with topography of western escarpment and neighbouring Namaqualand, boardering the Atlantic seaboard. Species occurrence may be expected to continue from the Northern

Cape Province to the neighbouring Namibia. The distribution pattern observed in *Kazimierzus* may be influenced by the soil, vegetation (Succulent Karoo Biome) or habitat transformation although this has never been tested.

Remarks. There is currently one genus, *Kazimierzus,* in this family comprising the following species: *K. alipentus* (Plisko, 1998); *K. circulatus* (Plisko, 1998); *K. crousi* (Pickford, 1975); *K. davidi* (Plisko, 1998); *K. franciscus* (Pickford, 1975); *K. guntheri* (Pickford, 1975); *K. hamerae* (Plisko, 1998); *K. imitatus* (Plisko, 1998); *K. ljungstroemi* (Pickford, 1975); *K. metandrus* (Plisko, 1998); *K. obscurus* (Plisko, 1998); *K. occidualis* (Plisko, 1998); *K. occiduus* (Plisko, 1998); *K. pauli* (Plisko, 1998); *K. pearsonianus* (Pickford, 1975); *K. pentus* (Plisko, 1998); *K. peringueyi* (Michaelsen, 1913); *K. rosai* (Michaelsen, 1908); *K. senarius* (Plisko, 1998); *K. sirgeli* (Plisko, 1996); *K. sophieae* (Plisko, 2002).

Discussion

The 21 indigenous megadrile species occurring in south-western Atlantic coast of South Africa accredited by Plisko (2006) to genus *Kazimierzus* evidently differ from the other members of the composite family Microchaetidae (*s. lato*) and deserve a family of their own. A study of types and other material together with findings and opinion of earlier authors confirm clear differences between Microchaetidae (*s. str.*) as it now stands and a new family Kazimierzidae.

Particular characters noted in the studied species are diagnostic and they also attracted attention of earlier researchers. Pickford (1975) found that the seminal vesicles extended backwards, and the 9/10 septum thicker than other septa, and declared this as a character unique to *K. ljungstroemi*. When more material became available, Plisko (1998) observed that these features occur in most species known from certain areas of south-western Atlantic coast of South Africa (mainly Namaqualand in Western Cape). The backwards extension of seminal vesicles into more than two segments was also found in other species collected in these areas but not in the species from other parts of South Africa (Plisko 1998).

The circulatory system in Kazimierzidae differs from that in the Microchaetidae. It is a single tube through the length of the whole body and was declared as exclusive to *Kazimierzus* by Plisko (2006). The dorsal blood vessel in the Microchaetidae is double in anterior segments, simple when passing septa and forming a cordiform structure in segments 8, 9 noted by Plisko (1991, 1992, 2000, 2002, 2003, 2005, 2006, 2013).

The excretory system in the Microchaetidae is holoic with V–shaped nephridial bladders unlike in studied species where the excretory system although holoic the nephridial bladders are proclinate J–shaped. It should be noted that in *K. ljungstroemi* the nephridial bladders may be not seen clearly as J– shaped although their curve–shape suggests its similarity to a J–shape. The septum 6/7 is thickened in the Kazimierzidae whilst in the Microchaetidae it is much thinner or missing in some microchaetid species. The Kazimierzidae specimens are small to medium size, rarely extending more than 350 mm in length, while in some of microchaetids the body length may reach 2 m in addition the segment number (100–550) differs from the species in the Microchaeti-

dae. Although the majority of the Kazimierzidae species is holandric, the metandric character was observed, whilst in the Microchaetidae no species is metandric.

Pickford (1975) and Plisko (1996, 1998, 1992, 2008) noted these unique features, characteristic for the species occurring in Western Cape but never observed in *Geogenia*, *Proandricus* and *Microchaetus* (*s.str.*) in the composite Microchaetidae. This was highlighted by Plisko (2006) when a new genus *Kazimierzus* was erected for these 21 species. The current review of this genus confirms earlier supporting observations and leads to proposed erection of the new family Kazimierzidae.

In South African soils there are variable megadrile species accredited to indigenous families Microchaetidae, Tritogeniidae, Acanthodrilinae, presently newly erected Kazimierzidae and also representatives of foreign Lumbricidae, Glossoscolecidae, Megascolecidae, Eudrilidae, Ocnerodrilidae and Benhamiinae (Nxele et al. 2015, Plisko and Nxele 2015, Janion–Scheepers et al. 2016). The majority of species not native to South African soils occur in variable biotopes; these may have been transported intentionally or accidentally by humans, or dispersed naturally. These taxa may be found in natural biotopes and also in cultivated, agriculture lands, in undisturbed areas and in polluted areas (Plisko 2010). South African endemic species tend to have a restricted distribution and occur in natural, undisturbed or less disturbed biotopes, mostly in primary grasslands and forests (Plisko 1995, 2000; Nxele 2014). The species presently assigned to Kazimierzidae occur in the area known for endemism in its invertebrate fauna and associated with diverse flora. Kazimierzidae species are endemic to small areas restricted in the western and south-western Atlantic coast of South Africa. This geographical distribution and their unique characters lead to increased interest in erection of a new family to accommodate this genus. The re-assessment of generic characters for the new family Kazimierzidae compared with features occurring in the microchaetid genera *Microchaetus* Rapp, 1849 (*s. str.*), *Geogenia* Kinberg, 1867 and *Proandricus* Plisko, 1992 accredited to Microchaetidae is clearly presented in Table 1.

The restricted range of the Kazimierzidae species makes them vulnerable to habitat transformation due to their poor dispersal ability. The restricted distribution due to specific ecological requirements may lead to speciation. The species distribution of earthworms in Southern Africa is presently poorly known hence the urgency for extended study on earthworm diversity and their distribution patterns. Extensive earth-

Table 1. Diagnostic characters for Kazimierzidae fam. n. and Microchaetidae.

Kazimierzidae fam. n. (with one genus *Kazimierzus*)	**Microchaetidae (with three genera: *Microchaetus*, *Geogenia*, *Proandricus*)**
Dorsal blood vessel simple through the whole body length	Dorsal blood vessel double in some preclitellar segments
Seminal vesicles confined to one or two segments or extending backwards up to segment 30	Seminal vesicles confined to one or two segments, not extending backwards
Nephridial bladders J–shaped	Nephridial bladders V-shaped
Septa 6/7 often thickened	Septa 6/7 often missing,
Endemic to limited regions in the western and south-western coastal Atlantic parts of South Africa	Microchaetidae (s.str.) do not occur in the area where are Kazimierzidae

worm collection in the western Atlantic coast may bring more data on this and other taxa. Furthermore, planned molecular studies on the megadrile occurring in the southern Africa may bring clarity to earthworm taxonomy.

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References

Csuzdi Cs, Sherlock E, Talla Kouete M, Doherty-Bone TM (2015) Four new earthworm species from the highlands of Cameroon with description of a new genus *Okudrilus* gen. n. (Oligochaeta: Eudrilidae & Acanthodrilidae). African Invertebrates 56(1): 25–38. doi: 10.5733/afin.056.0103

Janion-Scheepers C, Measey J, Braschler B, Chown SL, Coetzee L, Colville JF, Dames J, Davies AB, Davies SJ, Davis AL.V, Dippenaar-Schoeman AA, Duffy GA, Fourie D, Griffiths C, Haddad CR, Hamer M, Herbert DG, Hugo-Coetzee EA, Jacobs A, Jacobs K, van Rensburg CJ, Lamani S, Lotz LN, Louw SvdM, Lyle R, Malan AP, Marais M, Neethling J, Nxele TC, Plisko JD, Prendini L, Rink AN, Swart A, Theron P, Truter M, Ueckermann E, Uys VM, Villet MH, Willows-Munro S, Wilson JRU (2016) Soil biota in a megadiverse country: Current knowledge and future research directions in South Africa. Pedobiologia 59: 129–174. doi: 10.1016/j.pedobi.2016.03.004

Michaelsen W (1908) III. Annelida. A. Oligochaeten aus dem Westlichen Kapland. In: Schultze L (Ed.) Zoologische und antropologische Ergebnisse e. Forschungsreise im Südafrika. Bd 1. Lief. 2. Denkschriften der medizinisch-naturwissenchaftlichen Gesselschaft zu Jena 13: 30–42.

Michaelsen W (1913) The Oligochaeta of Natal and Zululand. Annals of the Natal Museum 2(4): 397–457.

Nxele TC (2014) Comments on problems appearing during identification of *Tritogenia* species (Oligochaeta: Tritogeniidae). In: Pavlíček T, Cardet P, Almeida MT, Pascoal C, Cássio F (Eds) Advances in Earthworm Taxonomy VI (Annelida: Oligochaeta). Proceedings of the 6th International Oligochaete Taxonomy Meeting (6th IOTM), Palmeira de Faro (Portugal), 22–25 April 2013. Zoology in the Middle East 60(2): 32–37.

Nxele TC (2015) A Taxonomic Revision of *Tritogenia* Kinberg, 1867 and *Michalakus* Plisko, 1996 (Oligochaeta, Tritogeniidae) ocurring in KwaZulu-Natal Midlands, South Africa, Based on Morphological and DNA Sequence Data. M.Sc. Thesis. University of KwaZulu-Natal.

Nxele TC, Lamani S, Measey GJ, Armstrong AJ, Plisko JD, Willows-Munro S, Janion-Scheepers C, Wilson JRU (2015) Studying earthworms (Annelida: Oligochaeta) in South Africa. African Invertebrates 56(3): 779–806. doi: 10.5733/afin.056.0319

Pickford GE (1975) Contributions to a study of South African Microchaetinae (Annelida: Oligochaeta). Transactions of the Connecticut Academy of Arts and Science 46: 13–76.

Plisko JD (1991) Two new species of *Microchaetus* Rapp, 1849 from the Eastern Cape Province of South Africa (Oligochaeta: Microchaetidae). Annals of the Natal Museum 32: 293–303.

Plisko JD (1992) The Microchaetidae of Natal, with descriptions of new species of *Microchaetus* Rapp and *Tritogenia* Kinberg, and the new genus *Proandricus* (Oligochaeta). Annals of the Natal Museum 33: 337–378.

Plisko JD (1995) New data on the biosystematics and distribution of *Microchaetus natalensis* (Kinberg, 1867) in north-eastern South Africa (Oligochaeta: Microchaetidae). Annals of the Natal Museum 36: 281–291.

Plisko JD (1996) Six new earthworm species of the southern African genus *Proandricus* Plisko, 1992 (Oligochaeta: Microchaetidae). Annals of the Natal Museum 37: 295–307.

Plisko JD (1998) New and little-known species of *Microchaetus* Rapp, 1849, with a key to all species and notes on the significance of certain morphological features (Oligochaeta: Microchaetidae). Annals of the Natal Museum 39: 249–300.

Plisko JD (2000) The role of nature reserves in the protection of the terrestrial earthworm fauna (Oligochaeta), based on the material from Dlinza Forest Nature Reserve (Kwazulu-Natal, South Africa). Lammergeyer 46: 75–80.

Plisko JD (2002) Three new earthworm species of *Microchaetus* Rapp, 1849, and new data on two earlier known species of this genus (Oligochaeta: Microchaetidae). African Invertebrates 43: 205–214.

Plisko JD (2003) Eleven new South African earthworms (Oligochaeta: Microchaetidae) with new information on some known species, and an inventory of the microchaetids of KwaZulu-Natal. African Invertebrates 44(2): 279–325.

Plisko JD (2005) Five new South African earthworm species of the family Microchaetidae (Oligochaeta) with exceptional anatomical features. African Invertebrates 46: 103–113.

Plisko JD (2006) A systematic reassessment of the genus *Microchaetus* Rapp, 1849: its amended definition, reinstatement of *Geogenia* Kinberg, 1867, and erection of a new genus *Kazimierzus* (Oligochaeta: Microchaetidae). African Invertebrates 47: 31–56.

Plisko JD (2010) Megadrile earthworm taxa introduced to South African soils (Oligochaeta: Acanthodrilidae, Eudrilidae, Glossoscolecidae, Lumbricidae, Megascolecidae, Ocnerodrilidae). African Invertebrates 51: 289–312. doi: 10.5733/afin.051.0204

Plisko JD (2013) A new family Tritogeniidae for the genera *Tritogenia* and *Michalakus*, earlier accredited to the composite Microchaetidae (Annelida: Oligochaeta). African Invertebrates 54: 69–92. doi: 10.5733/afin.054.0107

Plisko JD, Nxele TC (2015) An annotated key separating foreign earthworm species from the indigenous South African taxa (Oligochaeta: Acanthodrilidae, Eudrilidae, Glossoscolecidae, Lumbricidae, Megascolecidae, Microchaetidae, Ocnerodrilidae and Tritogeniidae). African Invertebrates 56(3): 663–708. doi: 10.5733/afin.056.0312